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SUBJECT: BARIUM-140 PROCESS

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CONFIDENTIAL COVER SHEET

X-847

INTRA-LABORATORY CORRESPONDENCE

OAK RIDGE NATIONAL LABORATORY

TO: M. E. Ramsey

DATE: November 26, 1956

SUBJECT: BARIUM-140 PROCESS

The purpose of this memorandum is to record some ideas concerning a possible extremely simple Ba^{140} process, particularly in view of the somewhat confused status of the production process scheduled to go into operation at another site in the near future.

The basic idea for what I shall call the "chloride process" was originated by the writer in about 1950, when it became evident that highly enriched, highly irradiated U^{235} fuel pieces would be available. Ba^{140} has always been prepared at ORNL by using natural uranium irradiated at modest fluxes, with fair success, even with such poor starting material. It is obvious that if one could use highly enriched, highly irradiated U^{235}, the job should be quite simple. Experience gained with very high-level radiochemical work in remote manipulator cells in the Radioisotope Area further pointed out that much of the work could be done in a cell of this type, thus avoiding the large outlay of money usually thought necessary for Ba processing.

The attached simplified flow sheet shows the fundamentals of the chloride process, most parts of which have been tested in an exploratory way.

A fuel piece is removed from the ORR after 30 days or so in residence at a power level of 20 Mw, and the plates (containing about 100 g of U^{235} for production of 100,000 curies of Ba) are sheared off under water. The plates are transferred in a water-cooled container to a manipulator cell containing a conical tantalum dissolver-precipitator. Using $NaOH$-$NaNO_3$ solution, the aluminum is dissolved from the alloy and the heavy metallic U-sludge settles to the bottom of the cone. The Na_2AlO_2 solution is decanted thru a suction tube and after washing, the sludge is dissolved in a minimum quantity of 8 N HCl. Temperature control is maintained by circulating refrigerant thru the jacket of the precipitator. The following steps are then taken.

1. Ba^{++} carrier is added as required.

2. HCl gas is passed thru the UCl_4-HCl solution, raising concentration to about 12 N. Cool to about 10° C. $BaCl_2$ precipitates, leaving everything else in solution.

3. Decant supernate (thru filter if necessary).

4. Wash, partially redissolve, with 8 N HCl. Then reprecipitate with HCl gas; decant.

5. Dissolve $BaCl_2$ in water and transfer to Stang reactor (<2 g Ba for 100,000 curies, except for added carrier). Radiation is only fairly intense because La daughter has passed into the waste.

6. Reprecipitate with 12 N HCl and/or 83% HNO_3, as required for purity.

7. Make last reprecipitation in small platinum vessel and transfer $BaCl_2$ [or $Ba(NO_3)_2$] crystals to platinum Gooch crucible. Suck crystals dry.

8. Close Gooch with platinum cap and transfer to a platinum canister for shipment. Measure product in calorimeter and cross-check with portable Victoreen R-meter.

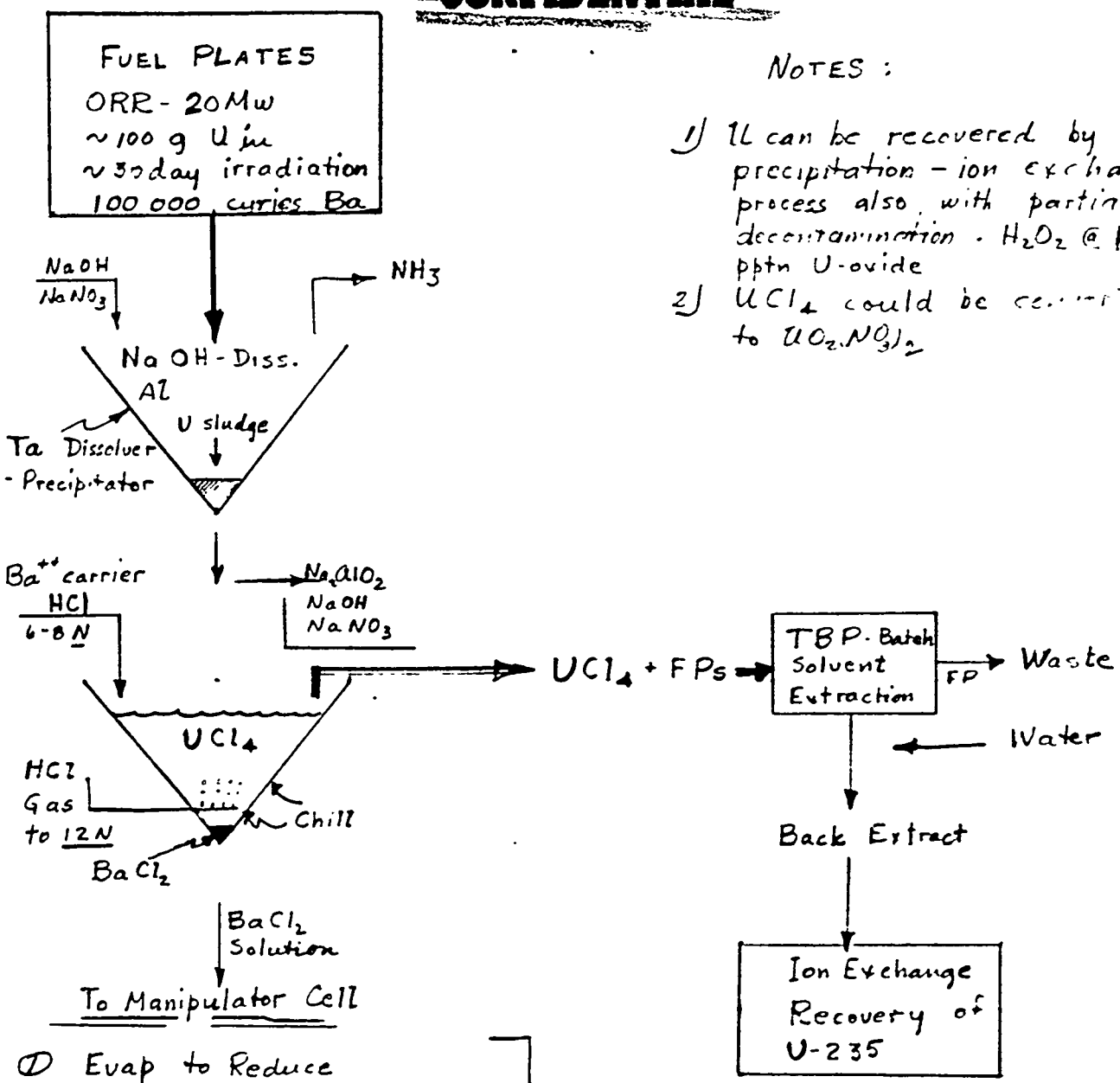
9. U^{235} can be recovered from the waste by solvent extraction or precipitation, and ion exchange.

Usually, product has been shipped as $Ba(NO_3)_2$, but I can see no good reason for this. $BaCl_2$ is more radiation stable than $Ba(NO_3)_2$, easier to handle, and the residual HCl is more easily evaporated from the product.

If it ever becomes necessary for ORNL to produce Ba again, this process should be looked into more deeply.

A. F. Rupp

AFR:jml



NOTES:

1) U can be recovered by precipitation - ion exchange process also with partial decontamination. H_2O_2 @ pH-5 pptn U-oxide

2) UCl_4 could be converted to $UO_2(NO_3)_2$

① Evap to Reduce Volume

② Ppt. $Ba(NO_3)_2$ with 83% HNO_3, Filter

③ Re-ppt with 12 N HCl and/or 83% HNO_3 as required for purity

④ Filter last $BaCl_2$ crystals and suck to dryness in Pt Filter - Gooch

⑤ Package for shipping

} LAB SCALE OPERATIONS

SIMPLIFIED FLOW SHEET FOR Ba 140 PRODUCTION

A.F. Rupp 11/20/56